Space Weather Technical Forecast

Issued on Tuesday, 26 October 2021 at 13:07 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Increased daily Chance of M-class flares.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity rose sharply to becoming Moderate in the 24-hour period, with background X-ray flux recorded at GOES 16 rising from mid-B class into C class, with occasional flares peaking at an M1.3 at 26/0247UTC. This flare emanated from a likely new region lying on the northeastern limb - with this likely to have been the source for several far-sided Coronal Mass Ejections (CMEs) and associated flares in the past week, as observed on coronagraph imagery. This potential region is one of up to six on the current disc, with these otherwise all appearing in the southern solar hemisphere, straddling 20S. The most noteworthy of these regions remains AR2887, which appears as a Dai Beta-Gamma, although it continues to deliver smaller flares than expected for its class. Also of note have been the rapid growth of AR2890 to reach Cri/Beta, and the more modest appearance of AR2889, which has reached Bxo/Beta, with remaining groups table and unipolar.

Overview of dimmings

	intensity	start	peak	end
October, 2021				
26	-401	09:45	09:54	10:33
26	-48	06:09	06:12	07:15
26	-20	05:33	05:33	06:03
26	-226	04:36	04:45	05:15
26	-194	02:24	03:09	04:00
26	-96	01:06	01:06	01:36
26	-25	00:36	00:36	01:00
25	-114	23:45	23:45	00:12
25	-91	22:12	22:18	23:09
25	-730	20:03	20:03	21:48
25	-8	16:51	16:51	17:15
24	-36	22:15	22:24	22:48
24	-130	07:12	07:18	07:57
23	-24	23:21	23:30	00:03
23	-4	13:24	13:24	13:51
22	0	21:09	21:09	21:33
22	-57	18:33	18:39	19:15
22	-188	17:36	17:42	18:24
22	-148	02:18	02:21	03:09
21	-33	22:09	22:09	22:33
21	-65	15:21	15:21	16:12
16	-23	22:21	22:24	23:24
15	-76	19:24	19:24	19:57
15	-15	15:18	15:21	16:12
15	-4	04:00	04:00	04:24
14	-223	18:36	18:54	19:18
13	-147	10:09	10:48	11:24
12	-434	02:09	02:48	03:54

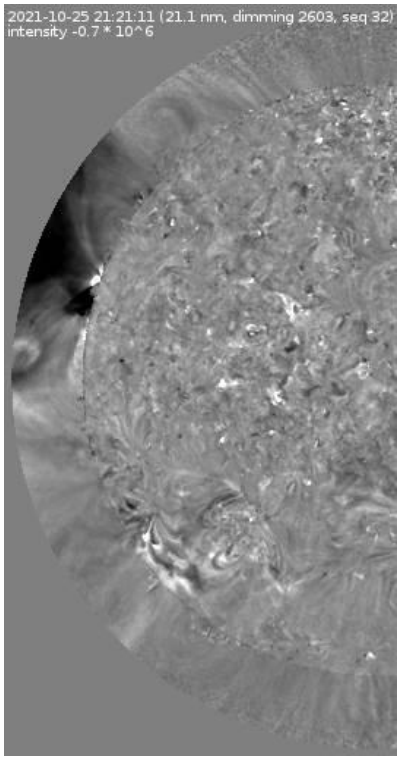

Figure 0: SIDC ROB dimming detection in AIA 211 data over the past fortnight (left, to 26/1100UTC), with the largest such event (25/2003UTC) shown right. Note the sharp increase in cadence of such features, which is strongly tied to the arrival of a possible new region in the northeast. Many of these events have been associated with non-Earth directed CMEs.

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While there are numerous filaments on the disc and there continue to be several eastward-heading CMEs from the possible limb region(s), there is no evidence of Earth-bound CMEs in available coronagraph imagery at present. A disappearing filament-like dimming was seen in AIA193 imagery (especially) around 26/1000UTC from the northwestern quadrant. At the time of writing, this is not appear to be tied to anything visible departing H-alpha imagery for the period. Coronagraphs will be monitored for any eventual appearance of any ejecta.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was at background levels throughout, ranging between 300 km/s to 360 km/s. The solar wind density was initially average, then rose above average between 25/1130-1700UTC with a peak around 28ppcc at 25/1500UTC. The IMF Bt was weak, with a brief peak to moderate (9nT) at 25/1530UTC. The north-south component was subsequently weak ranging from -5/+6 Bt. The phi angle remained almost exclusively negative (towards the sun). Resultant geomagnetic activity was Quiet (Kp 0-2) with one Unsettled interval (Kp 3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured by GOES-16 was at Background levels, with no solar radiation storms observed.

High energy electron flux (greater than 2MeV) was predominantly at background levels. Associated 24-hour electron fluence was well below the Active (1e8 integrated pfu) threshold, with 1.63e6 integrated pfu recorded at 26/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a daily Slight Chance of M-class flares, largely the result of the complexity of AR2887, although this has yet to be borne out in observed X-ray activity. There is a possible returning region just over the northeast limb that may yet increase probabilities over the next few days, however these do not yet feature in the percentages.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in this forecast period. CH15/+ is expected to become geoeffective early on Day 3 (28th). Due to its positive orientation and given it remains connected to the northern polar crown, a slight enhancement of solar wind speed is possible, perhaps bringing brief Unsettled or Active intervals on Day 3 in an otherwise Quiet geomagnetic period.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels, with no solar radiation storms currently expected. The high energy electron flux (greater than 2MeV) is likely to remain at Normal Background levels, with the 24-hour fluence expected to remain well below Active.

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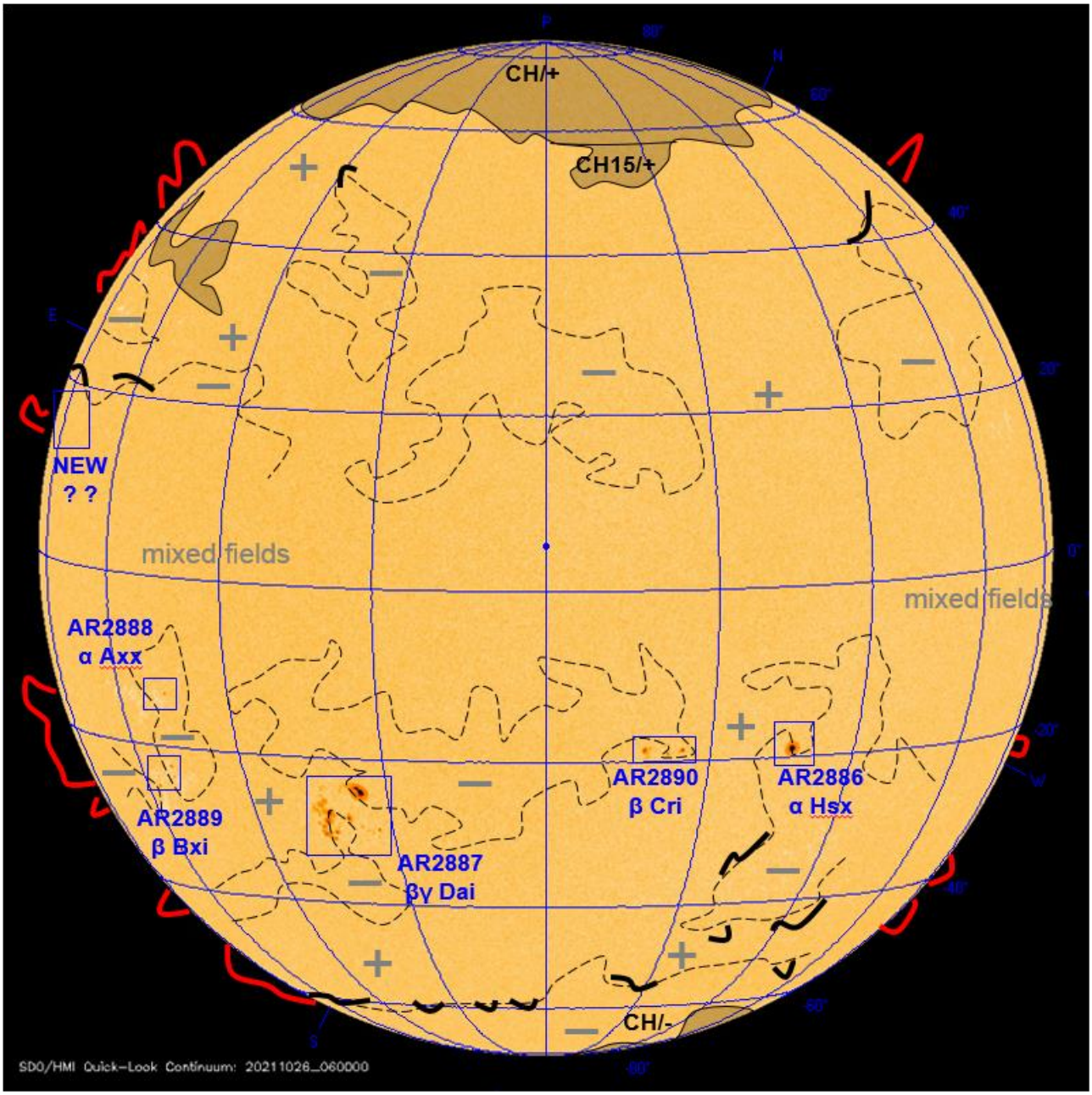
Figure 1. Solar Analysis Valid 26/0600UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the current four-day forecast. The increasingly marked regions of opposing magnetic polarity on the solar disc at present have given rise to numerous filaments, particularly one that circumscribes the south pole. These are something to monitor, but for now remain anchored in place.

The only coronal hole in the forecast is an solar equator-ward extension of the northern crown, denoted CH15/+. This more closely matches the previous rotation's appearance in recent days, however it has still yet to manifest at STEREO A, which lowers confidence in it becoming geoeffective. This is especially true as STEREO A is orbiting at a slightly higher solar latitude at present (7N versus 5N for Earth) and ought to be (slightly) more directly in line for effects. It may be that recent solar wind density increases here are related to skirting this coronal hole's influence, however the solar wind speed remains unmoved.

All in, confidence in seeing geomagnetism at Earth later this working week UTC are now reduced, with last rotation's peak of Active Kp perhaps now an upper estimate for activity on or around day three, Thursday 28 October.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

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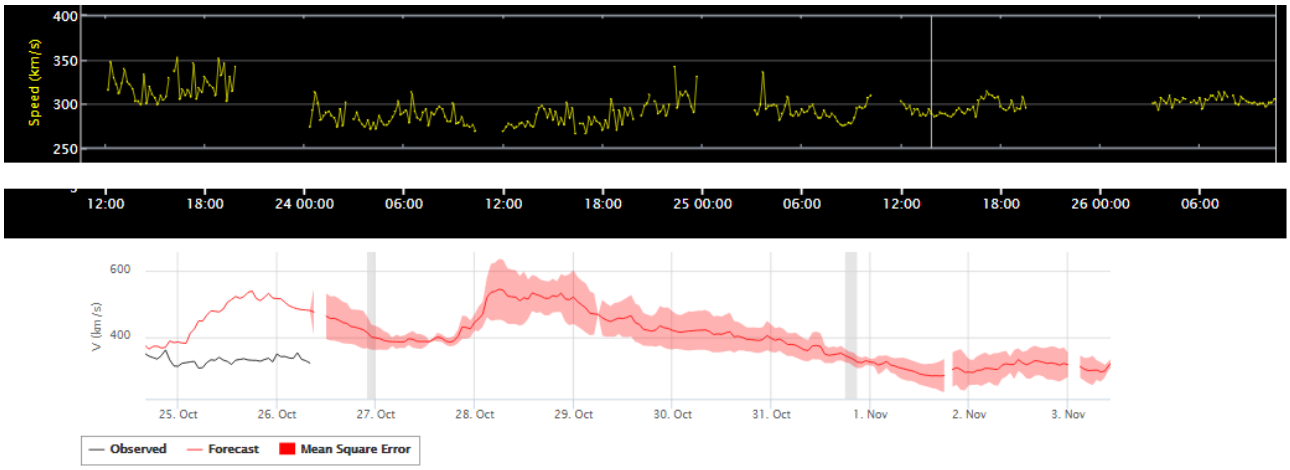
Figure 2: (Top) Past three days in STEREO A solar wind speed measurements, implying that CH15/+ is either late or very muted at the satellite and the SWPM persistence trace (below) is now less likely to be realised.



Radio Blackouts - X-Ray Flares:

The X-ray forecast and the risk of Radio Blackouts remain the most notable element of space weather at present. The sun is becoming very polarised and distinct in HMIBC imagery, with strong regions of opposing polarity, certainly compared with last working week.

The solar disc has become increasingly congested in recent days, particularly in the southern solar hemisphere, which has a near-continuous train east-to-west of sunspot regions in various states of development. The most nominally threatening of these regions remains AR2887, however despite appearances this sunspot group has so far failed to produce noteworthy activity.

The northern solar hemisphere had been quieter until the implied arrival of a new sunspot region lying on the northeastern limb late in the period - potentially the source of some recent far-sided CMEs and flares. The Penticton 10.7cm flux rose to match recent peaks (roughly a month apart) in excess of 100sfu as a result, and the background X-ray flux recorded at GOES 16 rose significantly from mid-B class into low C-class in the past 24 hours, paring back slightly as the period ended.

While this sunspot is not yet analysable, STEREO A EUVI 195 imagery suggests a potent region here, and the chances of M-class have been revised upwards to a daily 30% Chance, while C has increased to 90.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 M Class**	No	30	30	30	30
Very Active	**R3 to R5 X Class**	No	2	2	2	2

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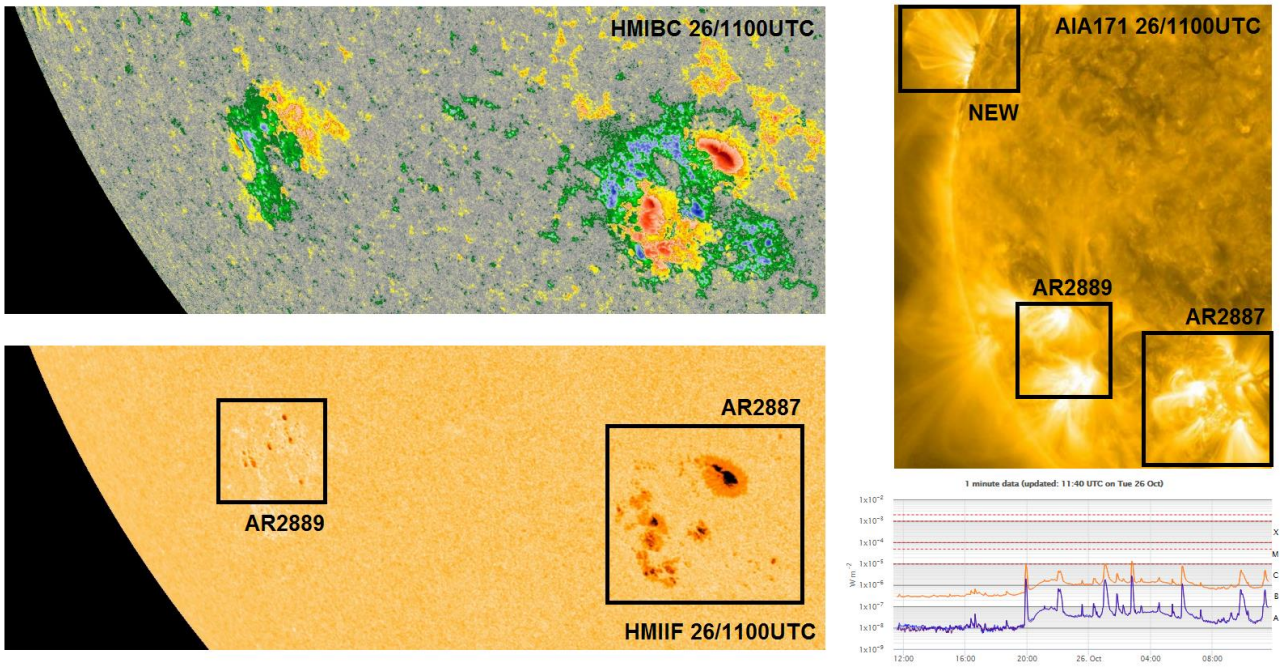
Figure 3: Clockwise from top left: HMIBC; AIA171; GOES 16 X-ray flux; HMIIF of current regions of interest for X-ray activity. Note especially the step-change in X-ray flux recorded in the final hours of the UTC day of onday 25 October as the potential new sunspot region rotated over the northeastern solar horizon.



Solar Radiation Storms - (High Energy Protons):

Although there are currently no significant sunspots in geoeffective positions on the Sun, if the potential northeastern limb region remains an active force as it progressively rotates towards the meridian later this week, the risk of S1 may rise. No solar radiation storms are currently expected, but this is under review.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux is currently at Normal Background levels, and may remain so throughout the forecast period. There are no CMEs in the forecast at present, and confidence in geomagnetism resulting from any effects of CH15/+ on or around day three, Thursday 28 October is now reduced, meaning that aside from a very slight uptick in uncertainty after CH15/+, the forecast is flat, with fluence unlikely to breach Active throughout.

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GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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